DOCUMENT RESUME

ED 427 724 IR 019 275

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TITLE Experiences from CSCW in Virtual Classrooms.
PUB DATE 1998-11-00
NOTE 7p.; In: WebNet 98 World Conference of the WWW, Internet and Intranet Proceedings (3rd, Orlando, FL, November 7-12, 1998); see IR 019 231. Figures may not reproduce clearly.
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; Computer Networks; Computer System Design; *Cooperative Learning; Distance Education; Foreign Countries; Higher Education; Hypermedia; *Information Networks; Information Technology; Interaction; *Open Education; Open Universities; Telecommunications; World Wide Web
IDENTIFIERS Finland; *Learning Environments; Virtual Classrooms; *Virtual Universities

ABSTRACT

The rapid development of modern information and communications technologies has opened new possibilities for establishing and delivering distance learning. In addition, the new learning paradigm based on cognitive learning theories can emphasize the quality of the learning process. The open learning environment that utilizes modern communications and information technologies can be described as a virtual organization. Virtual organization is a construct that provides services to the public by examining potential clients and service providers and dynamically assigning services to the clients. This paper discusses the application of virtual organizations to virtual learning structures such as virtual classrooms and virtual universities. As an example of a virtual classroom, a hypermedia course was implemented by the Finnish Open Technical University using the computer supported collaborative software (CSCW) called Basic Support for Collaborative Work (BSCW) and the World Wide Web. Experiences from the course are presented. Two figures present a network-based learning environment and a BSCW screen. (Author/AEF)

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Experiences from CSCW in Virtual Classrooms

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Abstract: The rapid development of modern information and communication technologies has opened new possibilites to establish and deliver distance learning. In addition, the new learning paradigm based on cognitive learning theories can emphasise the quality of the learning process. The open learning environment that utilises modern communication and information technologies can be described to be a virtual organisation. Virtual organisation is a construct that provides services to public by examining the potential clients and service providers and dynamically assigning services to the clients. This paper discusses of virtual organisations as a sturcture for virtual learning structures, such as virtual classrooms and virtual universities. As an example of virtual classroom a hypermedia course was implemented using computer supported collaborative software (CSCW) and WWW. Finally, experiences from the course are presented.

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I. INTRODUCTION

The rapid development of modern information and communication technologies has opened new possibilites to establish and deliver distance learning. In addition, the use of the new learning paradigm and open learning environments based on cognitive learning theories can emphasise the quality of the learning process. The open learning environment that utilises modern communication and information technologies can be characterised usig concept *virtual organisation*. Virtual organisation can be defined to be a construct that provides services (i.e. distance learning courses) to public by examining the potential clients and service providers and dynamically assigning services to the clients [Mowshowitz 1997].

Pori School of Technology and Economics is a network university in the sence that it is administered by two separate universities, namely Tampere University of Technology and Turku School of Economics. Our students have a strong background from work and after graduating they usually go back to their companies. This makes it natural to experiment with new ways to distribute courses and support studying at Pori School of Technology and Economics.

In this article we describe an experiment from a "Introduction to Hypermedia" course where computer supported collaborative work (CSCW) were used. The course was a part of a Finnish Open Technical University, AVOTEK [Avotek 1997]. AVOTEK could also be described as a virtual organisation.

Multisilta has earlier studied the learning of mathematics using hypermedia based learning environments [Multisilta 1996]. In general the experiences from such a learning environment were positive and the learning process were improved. In addition, hypermedia based learning environment motivated students more than normal classroom studying. Collis et. al. discusses the problems of using group-based project work in higher education and presents experiences from two courses that used Web-embedded shared workspaces [Collis et al. 1997].

From the technology point of view, Papandreou and Adamopoulos [Papandreou et al. 1997] has proposed a general framework for the application of distributed, broadband multimedia communication services for education and training. The framework is divided into four separate layers: infrastructure, distributed processing, groupware and application layer. Infrastructure layer consists of the computer system and network infrastructure. Distributed processing layer includes middleware, operating system and network interfaces. Groupware layer

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implements the basic services (i.e. CSCW tools, electronic document system and WWW) for educational multimedia applications that belong to the application layer.

Virtual organisation seems to provide more abstract framework to characterise broadband multimedia communication services for education and training. In the next section we try to define the concept virtual learning constructs using the framework of the virtual organisation.

II. VIRTUAL LEARNING CONSTRUCTS

Virtual learning constructs can be considered to be open learning environments that use modern communication and information technologies to implement the environment. More generally, virtual learning constructs are virtual organisations. Virtual organisation can be defined to be a construct that provides services (i.e. distance learning courses) to public by examining the potential clients and service providers and dynamically assigning services to the clients [Mowshowitz 1997]. In case of distance learning virtual organisations can be realised as virtual universities and virtual classrooms. The implementation of virtual universities and virtual classrooms requires software that supports team work in computer networks.

The elements used in virtual universities constitutes of an ideal *network based learning environment*. In this section we try to describe network based learning environments from the theoretical point of view. Generally, learning environment is a collection of topics [Siviter & Brown 1992]. A topic is a collection of educational activities, such as reading a piece of text, looking a picture, playing with a computer-based interactive device or searching information from the library. The general definition of the learning environment is based on the concept of learning-by-doing [Lehtinen 1997].

More technical point of view to the network based learning environment is to list the elements (hardware, software, information and people) that are needed in the network based learning environment. In order to learn by doing educational activities it is nessessary that network based learning environment consists of learning material as hypertext, problem solving tools (i.e. cognitive tools [Jonassen 1992]), communication and collaboration tools and external information resources. The active persons in the learning environment are students, teachers, experts and authors of the learning material. A person can have multiple roles in the network at the same time. For example, the students can sometimes be also the authors of the learning material. The network based learning environment is outlined in [Fig. 1].

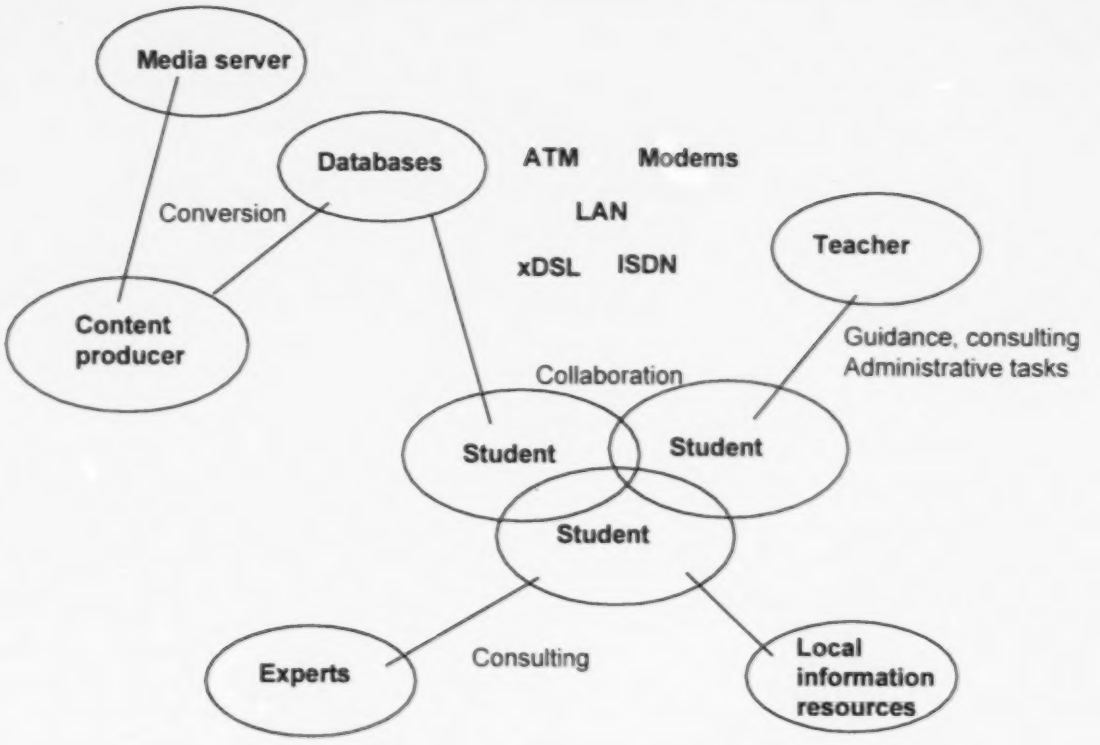

Figure 1: Network based learning environment.

An example of a cognitive tool can be a spreadsheet application that is used to solve a computational problem. By constructing a spreadsheet model the student is able to solve the problem. The construction and testing of the model is certainly a cognitive process.

Collaboration tools are tools that can be used by several students from different computers at the same time. Often a collaboration tool includes a shared workspace that can be graphics area or a word-processing document. The workspace can then be viewed and edited by several users at the same time. Examples of collaboration tools are shared whiteboard or shared calendar applications. Communication tools enable communication between the students and the teacher. The communication can be off-line (email) or on-line (audio- and video-conferencing applications). Also, the communication can be one-to-one, one-to-many, or many-to-many. Evaluation of several conferencing applications are presented in [Juell et al. 1996] and [Duran & Sauer 1997].

The type of the network conncetions in the user side and in the server side can considerably limit the type of the activities that can be delivered to the remote student. For example, the use of video material may be impossible in slow modem connections but acceptable in ISDN (Integrated Services Digital Network) connections. Furthermore, in the near future we will have broadband networks to home by using ADSL (Asymmetric Digital Subscriber Line) technologies. They enable real-time, broadcast quality video material to be distributed to home users using old copper cables.

There has not yet been many implementations of learning environments that can be described as a network based. For example, the survey of learning environments in mathematics in [Multisilta 1996] shows that many learning environments do not yet utilise communication technologies. The network based learning environments differ from local learning environments in the fact that in network based learning environments the information is loaded at least partly from the network and not from the local hard disk or CD-ROM. This fact must be remembered when desigining and implementing network based learning environments. Especially, the

three key factors for using networked information are: availability, reliability and usability. To some extent virtual universities solve these problems by providing reliable and usable information resources that are validated and revieved by the content specialists.

Availability of the Information

Availability means that information may be available and still be impossible to use. This is probably due to slow connections that prevent the use of large video materials. If it takes several minutes to load a one minute video sequense then it can be said that the material is not really available.

Reliability of the Information

Reliability means how to be sure about the correctness of the information. Partly this problem is solved when the material is delivered thru virtual university that validates the material. Also, the material from well-know organisations such as big publishers or research institutes may be considered to at least as reliable as their printed versions.

Usability of the Information

The problem of finding information from WWW has been well-known since the beginning of the WWW-age. Currently, there are many search engines available that examine the contents of WWW-sites and catalog this information to their databases. Searching these databases can give first hand knowledge of meaningful information sources. However, many of the search "hits" may be rubbish or the referrein page does not anymore exist. So still the question remains that how to find relevant information and especially how to find information that can be understood with my backgound knowledge and skills.

III. EXPERIENCES USING CSCW

Pori School of Technology and Economics has developed a course "Introduction to Hypermedia" to be distributed using WWW. The course were delivered as a part of Finnish Virtual Open University of Technology - project (e.g. AVOTEK in Finnish) [Karjalainen & Hiltunen 1997]. The AVOTEK is the first step in building a virtual university in Finland and "Introduction to Hypermedia" course can be described as a virtual classroom inside the virtual university. The course was implemented using software called BSCW (Basic Support for Collaborative Work, [BSCW 1997]). The course were delivered first time during autumn -97. There were 10 persons that took the course. On summer -98 the course was done again wit more than 90 students.

The course was started by informing the students by email. In response to the email the students registered themselves to the BSCW. Each week the teacher created a short description of the topic of the week and included reference material (i.e. verified links). The description were posted to the BSCW. In addition, the teacher created exercises that the students processed every week.

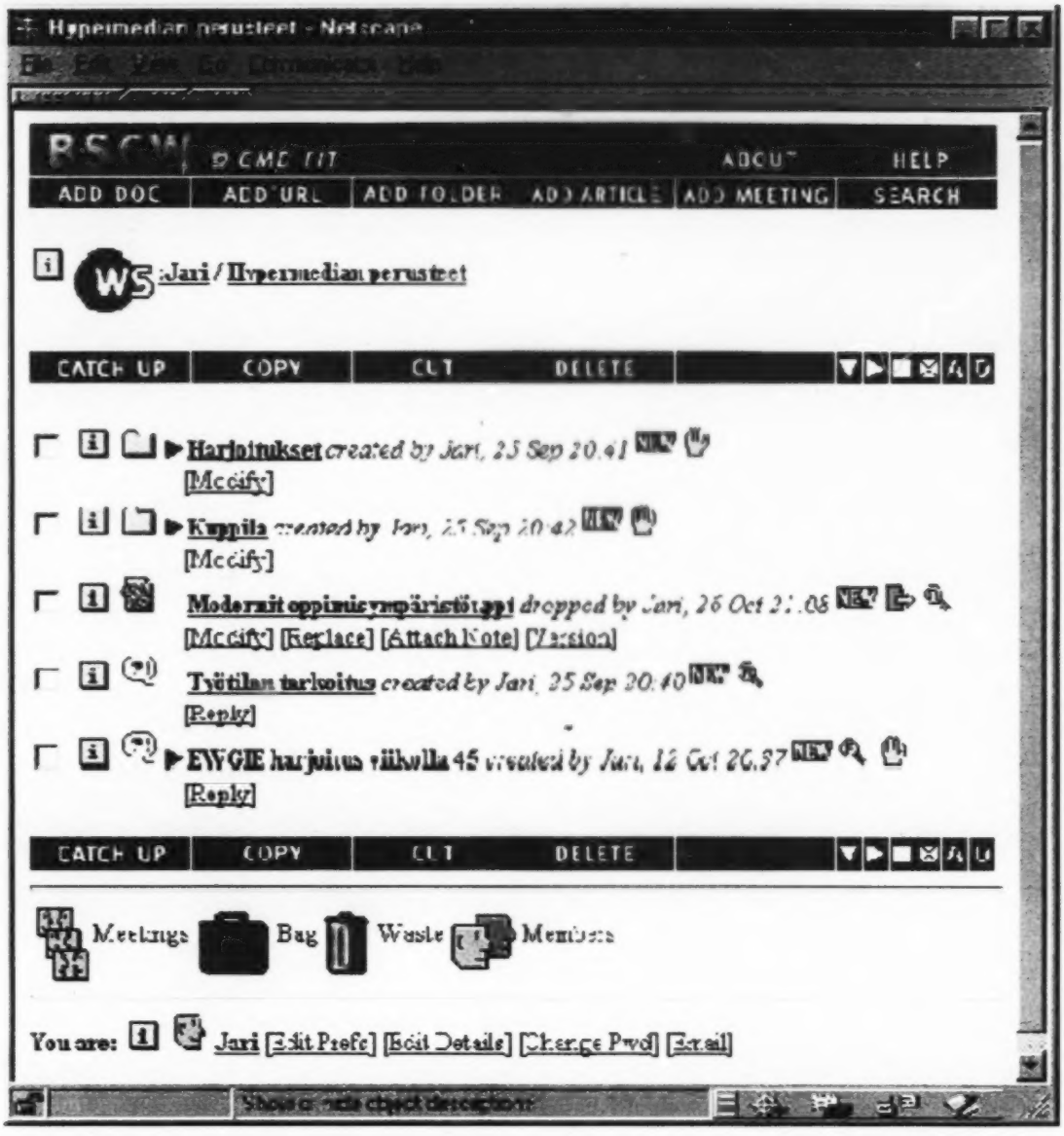

Figure 2: BSCW software for computer-supported collaborative work.

The experiences from the first course were encouraging. In general, the students were highly motivated on learning using modern learning environment. The students had a good knowledge on using computers and WWW. This is why it was possible to start to without first teaching to the students how to use the tools (i.e. computer, Windows 95 and WWW).

During the learning experiments it was noticed that different forms of interactivity needs to be studied more carefully. Some student groups succeeded in using CSCW tools in the learning while others had a lot of difficulties. For example, one exercise during the course was to study one of the makers of the hypertext history. The persons to be studied were Vannever Bush, Dough Engelbart, Ted Nelson and Tim Berners-Lee. The group

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who studied Ted Nelson did a web-page[1] where they included a picture of Ted borrowed from Ted's own home page[2]. In his home-page, Ted Nelson encourages people to use his picture in other web pages but leave a note (transcopyright). Sometimes Ted checks the transcopyrighted pages. The gropumembers were extremely happy when Ted visited their Ted Nelson page and emailed his thanks to them. This way the group learned the history of the hypertext, the concept of transcopyright, the making of the web page using CSCW and even got a great reward.

Another experiment with CSCW has been carried out with health care experts participating in continuing education. The aim of this course was to learn to use modern communication technologies as a part of their every day work. Groups participating from different hospitals and different departments did a project work using WWW, BSCW and email. The topics of the project work were health care task descriptions and descriptions of healt care procedures at home and self-medicin.

IV. CONCLUSION

In this paper, we charasterised distance learning as a virtual organisation i.e. virtual classroom. Technologies to be used at virtual classrooms include videoconferencing and computer-supported collaborative work software. These technologies were used in teaching students in multimedia course and health care experts in continuing education. So far the feedback has been good.

During the learning experiments it was noticed that different forms of interactivity needs to be studied more carefully. Some student groups succeeded in using CSCW tools in the learning while others had a lot of difficulties.

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